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HOST-PLANT RELATIONS OF *TRUPANEA* SPP. (DIPTERA: TEPHRITIDAE) IN SOUTHERN CALIFORNIA

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Abstract.—Many new rearing records are reported for nine of 15 species of *Trupanea* occurring in California. The host relations of all 15 species are assessed, including two species for which hosts remain unknown, two monophagous species, five oligophagous species, and six generalist species, all restricted to Asteraceae. The numbers of flies reared from flower head samples from the different hosts of each species of *Trupanea* also varied considerably.

Five years ago I began long-term studies on the biology and ecology of flower-head infesting and gall-forming fruit flies (Diptera: Tephritidae) in southern California, that section of the state defined and treated by Munz (1974). I report here many new rearing records for several species of *Trupanea*, the most common genus of nonfrugivorous Tephritidae encountered in southern California, and briefly characterize their host affinities in light of these new records.

MATERIALS AND METHODS

Mature flower heads of Asteraceae were sampled as encountered during wide-ranging field research on a variety of entomological projects throughout southern California during 1980–1984. Samples of excised heads and a few whole plants for use in identification were transported in individual, sealed, 23 × 30.5-cm, polyethylene plastic bags in a cold chest to the University of California at Riverside. The number of heads sampled varied with their availability and inversely with their size, but usually comprised a full bag of one to several hundred heads. Following temporary storage for up to 1 week in a refrigerator at 2°C, the plants were identified and the flower head samples separately caged in the insectary of the Division of Biological Control at 26 ± 1°C and a 12-h or 16-h photoperiod in glass-topped, wooden, sleeve cages described by Gilstrap and Goeden (1974). Samples were spread on the bare cage floors and held for 2 weeks to 1 month, depending on the amount and duration of fly emergence. A hygroscopic mixture of honey (five parts) : yeast hydrolyzate (two parts) narrowly streaked on the underside of the cage top provided a temporary food and moisture source for emerged flies. Bi-weekly collections of the fully colored, 2–3 day old flies were made and the number and sex of all tephritid species recovered from each sample recorded.

RESULTS

New host-plant genus or species rearing records determined by comparison with Wasbauer (1972) for nine of 15 species of *Trupanea* reported from southern

California by Foote and Blanc (1963) are listed below. Host-plant records that are not reported in Wasbauer (1972) are labelled with a double or single asterisk for genera and species, respectively. Among multiple samples of a particular plant species, only the sample from which the most individuals of each fly species was recovered is reported. The plant nomenclature used follows Munz (1974); the insect nomenclature, Foote (1960), and Foote and Blanc (1963). Rearing records for the flies and their host plants are listed alphabetically.

Trupanea actinobola (Loew), 43 ♂ and 28 ♀, ***Acamptopappus shockleyi* Gray, SE end Kingston Range, NE San Bernardino Co., 27.v.1982; 12 ♂ and 13 ♀, ***A. sphaerocephalus* (Harvey and Gray) Gray, Phelan, SW San Bernardino Co., 27.v.1980; 1 ♂, ***Achillea millefolium* L. var. *californica* (Pollard) Jepson, Corralilos Canyon, W Santa Barbara Co., 28.vi.1983; 33 ♂ and 32 ♀, ***Baileya multiradiata* Harvey and Gray, Piute Valley, E San Bernardino Co., 24.iii.1982; 34 ♂ and 37 ♀, ***Dyssodia pentachaeta* (de Candolle) Robinson ssp. *pentachaeta* var. *belenidium* (de Candolle) Strother, S of Mountain Pass, SE of Mescal Range, NE San Bernardino Co., 20.ix.1983; 1 ♂, ***Erigeron foliosus* Nuttall, W of Tehachapi, Kern Co., 12.vii.1983; 13 ♂ and 9 ♀, ***Gutierrezia microcephala* (de Candolle) Gray, N of Mercury Mountain, NE San Bernardino Co., 20.x.1982; 1 ♀, ***Heterotheca grandiflora* Nuttall, Pine Valley, San Diego Co., 18.ix.1980; 1 ♀, ***Lepidospartum squamatum* (Gray) Gray, Cajon Junction, SW San Bernardino Co., 9.ix.1981; 1 ♂, ***Porophyllum gracile* Bentham, Turquoise Mountain, NE San Bernardino Co., 29.iv.1981; 1 ♂, **Solidago confinis* Gray, W shore of Lake Hemet, San Jacinto Mountains, San Bernardino Nat. Forest, Riverside Co., 29.ix.1982; 58 ♂ and 31 ♀, ***Trixis californica* Kellogg, Chino Canyon, Riverside Co., 9.iv.1981.

Trupanea californica Malloch, 62 ♂ and 42 ♀, **Gnaphalium beneolens* Davidson, W shore of Lake Hemet, San Jacinto Mountains, San Bernardino Nat. Forest, Riverside Co., 29.ix.1982; 21 ♂ and 15 ♀, **Gnaphalium bicolor* Biolette, Grapevine Canyon, San Diego Co., 9.ii.1984; 9 ♂ and 11 ♀, **Gnaphalium californicum*, Los Osos, San Luis Obispo Co., 29.vi.1983.

Trupanea femoralis (Thomson), 1 ♀, **Haplopappus acradenius* (Greene) Blake ssp. *eremophilus* (Greene) Hall, Mountain Springs, SW Imperial Co., 14.x.1981; 1 ♂ and 4 ♀, **Haplopappus linearifolius* de Candolle, Devil's Punchbowl, Los Angeles Co., 27.v.1980; 2 ♂ and 1 ♀, **Haplopappus pinifolius* Gray, McCain Valley, San Diego Co., 16.x.1980; 3 ♂ and 1 ♀, **Hemizonia floribunda* Gray, Lark Canyon, San Diego Co., 16.x.1980; 11 ♂ and 4 ♀, ***Lepidospartum squamatum*, Snow Creek, Riverside Co., 20.x.1981; 2 ♂, ***Peucephyllum schottii* (Gray) Gray, N side of Graham Pass, Riverside Co., 21.iii.1984.

Trupanea imperfecta (Coquillett), 1 ♀, ***Ambrosia ilicifolia* (Gray) Payne, Signal Mountain, Imperial Co., 25.ii.1981; 1 ♀, ***Coreopsis gigantea* (Kellogg) Hall, Ocean Beach, Santa Barbara Co., 18.iv.1980.

Trupanea jonesi Curran, 6 ♂ and 3 ♀, ***Agoseris heterophylla* (Nuttall) Greene, Figueroa Mountain, San Rafael Wilderness, Santa Barbara Co., 21.v.1981; 1 ♀, ***Artemisia douglasiana* Besser in Hooker, Kitchen Creek, San Diego Co., 16.ix.1981; 1 ♂ and 3 ♀, ***Artemisia dracunculus* L., Mahogany Creek, Sequoia Nat. Forest, Tulare Co., 11.vii.1984; 3 ♂ and 2 ♀, ***Artemisia ludoviciana* Nuttall, Cienaga Creek, San Bernardino Nat. Forest, SW San Bernardino Co., 18.viii.1981; 2 ♂ and 3 ♀, ***Baccharis glutinosa* Persoon, Weldon Valley, Walker Pass, Kern Co., 25.iv.1984; 1 ♂ and 1 ♀, ***Baccharis sergiloides* Gray, Howe Spring, Pinto Valley, New York Mountains, NE San Bernardino Co., 9.ix.1981; 1 ♀, ***Baileya*

multiradiata, Mountain Pass, NE San Bernardino Co., 23.iv.1981; 10 ♂ and 12 ♀, ****Balsamorhiza deltoidea*** Nuttall, N of Burnt Peak, Angeles Nat. Forest, Los Angeles Co., 8.vi.1983; 28 ♂ and 5 ♀, ****Chaenactis douglasii*** (Hooker) Hooker and Arnott, Jackass Meadow, Sequoia Nat. Forest, SE Tulare Co., 26.vii.1983; 41 ♂ and 31 ♀, *****Chaenactis fremontii*** Gray, Snow Creek, Riverside Co., 9.iv.1981; 1 ♂ and 3 ♀, ****Chrysothamnus nauseosus*** (Pallas) Britton, Landers Meadow, Sequoia Nat. Forest, Kern Co., 3.ix.1981; 1 ♀, ****Chrysothamnus parryi*** (Gray) Greene ssp. *vulcanicus* (Greene) Hall and Clements, Evans Flat, Greenhorn Mountains, Sequoia Nat. Forest, Kern Co., 30.viii.1983; 3 ♂ and 4 ♀, ****Chrysothamnus viscidiflorus*** (Hooker) Nuttall, Landers Meadow, Sequoia Nat. Forest, Kern Co., 3.ix.1981; 2 ♂ and 3 ♀, ****Coreopsis douglasii*** (de Candolle) Hall, S of 29 Palms, S San Bernardino Co., 27.iv.1982; 3 ♀, ****Erigeron coulteri*** Porter, Onion Valley, Sierra Nevada Mountains, W Inyo Co., 14.ix.1982; 32 ♂ and 22 ♀, ****Erigeron peregrinus*** (Pursh) Greene ssp. *callianthemus* (Greene) Cronquist, Smith Meadows, Sequoia Nat. Forest, SE Tulare Co., 3.viii.1983; 1 ♂, *****Eriophyllum confertiflorum*** (de Candolle) Gray, Pioneertown, SW San Bernardino Co., 5.v.1981; 3 ♂ and 6 ♀, *****Eriophyllum pringlei*** Gray, Chimney Creek, Sequoia Nat. Forest, SE Tulare Co., 25.iv.1984; 5 ♂ and 4 ♀, *****Geraea canescens*** Torrey and Gray, Hidden Spring, W of Indio, Riverside Co., 14.iv.1981; 1 ♂, *****Hymenoxys cooperi*** (Gray) Cockerell var. *cooperi*, Caruthers Canyon, New York Mountains, NE San Bernardino Co., 31.viii.1982; 10 ♂ and 7 ♀, *****Layia glandulosa*** (Hooker) Hooker and Arnott, ssp. *glandulosa*, Pioneertown, SW San Bernardino Co., 5.v.1981; 22 ♂ and 23 ♀, *****Layia platyglossa*** (Fischer and Meyer) Gray prob. ssp. *campestris* Keck, Howard Canyon, Santa Barbara Co., 17.iv.1980; 2 ♀, *****Lepidospartum squamatum***, Cajon Junction, SW San Bernardino Co., 2.ix.1981; 1 ♂, *****Lessingia lemmonii*** Gray var. *lemmonii*, Cedar Canyon, NE San Bernardino Co., 9.ix.1981; 1 ♀, *****Perityle emoryi*** Torrey in Emory, S of Ibis, SW side of Dead Mountains, E San Bernardino Co., 24.iii.1982; 5 ♂ and 4 ♀, *****Senecio canus*** Hooker, N of Troy Meadows, Sequoia Nat. Forest, SE Tulare Co., 26.vii.1983; 11 ♂ and 5 ♀, *****Solidago occidentalis*** (Nuttall) Torrey and Gray, Kennedy Meadows, Sequoia Nat. Forest, Tulare Co., 26.ix.1980; 1 ♀, *****Stephanomeria virgata*** Bentham, Cuddy Valley, Los Padres Nat. Forest, SW Kern Co., 31.viii.1983; 13 ♂ and 16 ♀, *****Tetradymia spinosa*** Hooker and Arnott var. *longispina* Jones, Pioneertown, SW San Bernardino Co., 5.vi.1981.

Trupanea nigricornis (Coquillett) (does not include rearing records cited by Cavender and Goeden (1983)), 16 ♂ and 5 ♀, ****Acamptopappus shockleyi***, SE end Kingston Range, NE San Bernardino Co., 27.v.1982; 1 ♂, ****Brickellia californica*** (Torrey and Gray) Gray, S end Ivanpah Mountains, NE San Bernardino Co., 21.x.1982; 1 ♀, ****Brickellia desertorum*** Coville, Colton Well, NE San Bernardino Co., 21.x.1982; 3 ♂ and 4 ♀, ****Brickellia incana*** Gray, Sacramento Spring (S of Colton Hills and E of Mitchell Caverns), NE San Bernardino Co., 21.x.1982; 2 ♂ and 1 ♀, ****Brickellia oblongifolia*** Nuttall var. *linifolia* (D. C. Eaton) Robinson, Opal Canyon, Inyo Nat. Forest, NE Inyo Co., 30.vi.1982; 3 ♂ and 5 ♀, *****Chaenactis carphoclina*** Gray, Sheephole Mountains, SE San Bernardino Co., 10.iv.1984; 18 ♂ and 20 ♀, ****Chrysothamnus paniculatus*** (Gray) Hall, N Alabama Hills, Inyo Co., 8.vi.1982; 10 ♂ and 16 ♀, *****Dyssodia cooperi*** Gray, NW of Stepladder Mountains, SE San Bernardino Co., 22.x.1982; 2 ♂ and 1 ♀, *****Erigeron peregrinus*** ssp. *callianthemus*, Smith Meadows, Sequoia Nat. Forest, SE Tulare Co., 3.viii.1983; 16

♂ and 24 ♀, ***Haplopappus acradenius* ssp. *acradenius*, Saeramento Spring, NE San Bernardino Co., 21.x.1982; 3 ♂ and 2 ♀, **Haplopappus cuneatus* Gray, S end of Ivanpah Mountains, NE San Bernardino Co., 21.x.1982; 18 ♂ and 20 ♀, **Haplopappus paniculatus* (Gray) Hall, N Alabama Hills, Inyo Co., 8.vi.1982; 2 ♂ and 4 ♀, **Haplopappus parishii* (Greene) Blake, Garnet Mountain, San Diego Co., 9.ix.1980; 5 ♂ and 9 ♀, **Haplopappus pinifolius* Gray, McCain Valley, San Diego Co., 16.x.1980; 3 ♂ and 2 ♀, ***Hymenoxys cooperi*, Caruthers Canyon, New York Mountains, NE San Bernardino Co., 31.viii.1982; 2 ♀, ***Leucelene ericoides* (Torrey) Greene, Death Valley Road above Eureka Valley, NE Inyo Co., 5.vi.1984; 1 ♂ and 1 ♀, ***Pleurocoronis pluriseta* (Gray) King and Robinson, NW of Coxcomb Mountains, SE San Bernardino Co., 20.iii.1984; 4 ♂ and 5 ♀, ***Senecio canus*, N of Troy Meadows, Sequoia Nat. Forest, SE Tulare Co., 26.vii.1983; 1 ♀, **Solidago confinis* Gray, Antelope Spring, NE Inyo Co., 15.ix.1982; 5 ♂ and 4 ♀, ***Tetradymia axillaris* A. Nelson, Marble Canyon, Inyo Nat. Forest, Inyo Co., 30.vi.1982; 6 ♂ and 6 ♀, ***Tetradymia canescens* de Candolle, 1 km E of Aspen Grove, San Bernardino Nat. Forest, SW San Bernardino Co., 19.viii.1982; 1 ♂, ***Tetradymia spinosa* Hooker and Arnott var. *longispina* Jones, Weldon Valley, Walker Pass, Kern Co., 25.iv.1984; 15 ♂ and 3 ♀, **Viguiera multiflora* (Nuttall) Blake var. *nevadensis* (A. Nelson) Blake, S of Mountain Pass, SE side of Mescal Range, NE San Bernardino Co., 20.ix.1983.

Trupanea radifera (Coquillett), 1 ♂ and 1 ♀, ***Aster scopulorum* Gray, Cowhorn Valley, N Inyo Nat. Forest, NE Inyo Co., 30.vi.1982; 1 ♂, ***Baileya pauciradiata* Harvey and Gray, sand dunes near Hidden Springs (W of Indio), Riverside Co., 14.iv.1981; 1 ♂, ***Chrysothamnus viscidiflorus*, Antelope Spring, NE Inyo Co., 15.ix.1982; 3 ♂ and 6 ♀, ***Eriophyllum wallacei* Gray, Sheephole Mountains, SE San Bernardino Co., 10.iv.1984; 31 ♂ and 26 ♀, ***Machaeranthera tortifolia* (Gray) Cronquist and Keck, S of former site of Fort Piute, Piute Range, NE San Bernardino Co., 18.iii.1982; 44 ♂ and 43 ♀, ***Malacothrix coulteri* Gray, Rainbow Basin (N of Barstow), NW San Bernardino Co., 16.iv.1983; 102 ♂ and 93 ♀, ***Malacothrix glabrata* Gray, Sheephole Mountains, SE San Bernardino Co., 10.iv.1984; 4 ♂ and 6 ♀, ***Microseris linearifolia* (de Candolle) Schultz-Bipontinus, 5 km W of Aguanga, SW Riverside Co., 11.v.1982; 2 ♂ and 10 ♀, ***Monoptilon bellioides* (Gray) Hall, 7 km NW of Manix, NW San Bernardino Co., 5.v.1982; 44 ♂ and 71 ♀, ***Nicolletia occidentalis* Gray, Alvord Mountain (between Baker and Barstow), NW San Bernardino Co., 23.iv.1982; 33 ♂ and 26 ♀, ***Palafoxia linearis* (Cavanilles) Lagasca y Segura var. *gigantea* Jones, Sand Hills (W of Glamis), Imperial Co., 28.i.1982; 37 ♂ and 26 ♀, ***Palafoxia linearis* var. *linearis*, Big Morongo Canyon, Riverside Co., 15.iv.1984; 33 ♂ and 30 ♀, ***Perityle emoryi*, Chemhuevi Wash (at West Well S of Needles), E San Bernardino Co., 16.iii.1982; 1 ♀, ***Pleurocoronis pluriseta*, N slope of Graham Pass, E Riverside Co., 21.iii.1984; 7 ♂ and 1 ♀, ***Rafinesquia neomexicana* Gray, Rainbow Basin, NW San Bernardino Co., 29.iv.1982.

Trupanea vicinia (van der Wulp), 3 ♀, ***Coreopsis douglasii*, S of 29 Palms, S San Bernardino Co., 27.iv.1982; 1 ♀, ***Dyssodia porophylloides* Gray, Grapevine Canyon, San Diego Co., 30.iv.1982; 1 ♀, ***Nicolletia occidentalis*, SE of Alvord Mountain (between Barstow and Baker), NW San Bernardino Co., 23.iv.1982.

Trupanea wheeleri Curran, 1 ♀, ***Acamptopappus shockleyi* Gray, Aguerreberry Point, Panamint Range, Inyo Co., 9.vi.1982; 2 ♂ and 2 ♀, ***Brickellia californica*,

Quatal Canyon, Los Padres Nat. Forest, S Kern Co., 31.viii.1983; 1 ♀, ****Chrysopsis villosa,** Cuddy Valley, Los Padres Nat. Forest, S Kern Co., 31.viii.1983; 2 ♀, ****Chrysothamnus nauseosus,** atop Mt. Pinos, Los Padres Nat. Forest, Ventura Co., 7.ix.1982; 1 ♂ and 1 ♀, ****Chrysothamnus parryi** ssp. *asper* (Greene) Hall and Clements, Squirrel Meadow, Sequoia Nat. Forest, Kern Co., 2.ix.1981; 5 ♂ and 2 ♀, ***Encelia farinosa** Gray ex Torrey, Chino Canyon, Riverside Co., 3.iv.1980; 9 ♂ and 3 ♀, ***Encelia virginensis,** Cactus Canyon, Riverside Co., 29.iv.1980; 4 ♂ and 6 ♀, ****Eriophyllum confertiflorum,** S side of Refugio Pass, Santa Barbara Co., 17.vi.1980; 1 ♂ and 3 ♀, ***Haplopappus cuneatus,** Lark Canyon, San Diego Co., 16.x.1980; 6 ♂ and 7 ♀, ***Haplopappus ericoides** (Lessing) Hooker and Arnott ssp. *blakei* C. B. Wolf, Orcutt, Santa Barbara Co., 7.xii.1982; 11 ♂ and 7 ♀, ***Haplopappus parishii,** Descanso Junction, San Diego Co., 16.x.1980; 1 ♂ and 4 ♀, ***Haplopappus pinifolius,** McCain Valley, San Diego Co., 16.x.1980; 24 ♂ and 19 ♀, ***Haplopappus propinquus** Blake, Kitchen Creek, Cleveland Nat. Forest, San Diego Co., 14.x.1981; 1 ♂ and 2 ♀, ***Haplopappus venetus** ssp. *furfuraceus* (Greene) Hall, Proctor Valley, SW San Diego Co., 28.x.1981; 1 ♂ and 3 ♀, ****Hemizonia floribunda,** Lark Canyon, San Diego Co., 16.x.1980; 1 ♀, ****Perityle emoryi,** Travertine Rocks, Imperial Co., 15.iv.1980.

Discussion

In his revision of the genus *Trupanea,* Foote (1960) noted that no concerted effort had been made to evaluate the host specificity of this worldwide, largely non-economic taxon or to study the biology of any species. Foote and Blanc (1963) listed collection and rearing records for *Trupanea* from California, which include 15 of 20 species known from North America north of Mexico. They remarked that the host specificities of the California species of *Trupanea* remained largely undefined. Wasbauer (1972) cataloged both published and unpublished host records for North American Tephritidae, including *Trupanea.* Stegmaier (1968) studied the biology of *T. actinobola* in Florida and discussed its known host relationships. Cavender and Goeden (1982, 1983) described the life history of *T. bisetosa* (Coquillett) and discussed how its host specificity helped to distinguish this species from *T. nigricornis.* These references contain most published knowledge of the host relations of North American *Trupanea.*

The many rearing records reported herein allow an initial analysis to be made of the host specificity of *Trupanea* species in California. It is readily apparent that considerable differences exist in the host specificity of the various species. Degrees of specificity represented vary from the narrow monophagy of *T. conjuncta* (Adams), which only reproduces on *Trixis californica* (Goeden, 1983; Goeden and Ricker, unpublished data); to oligophagous species like *T. californica,* which infests heads of several species each of the closely related genera, *Anaphalis* and *Gnaphalium* (Wasbauer, 1972), in the tribe Inulae (Munz and Keck, 1959); to generalist species like *T. jonesi,* which is now known from 29 genera and 41 species of Asteraceae (Wasbauer, 1972, and in the present work). Between the extremes in host specificity represented by *T. conjuncta* and *T. jonesi* lie the 11 other species of *Trupanea* from California for which at least some host data are available.

I have not yet reared *T. arizonensis* Malloch or *T. maculigera* Foote, for which Wasbauer (1972) also listed "no host information." These two species were rep-

resented by records for only five and nine individuals, respectively, all collected by sweeping (Foote and Blanc, 1963). Both species presumably have very restricted host ranges in California. The distributional data for *T. arizonensis* in Foote and Blanc (1963) and my sweeping samples suggest that this fly infests the heads of a fairly widespread host, and for *T. maculigera*, that its unknown host is of extreme southern distribution in California.

Trupanea pseudovicina Hering has only been reported from *Bebbia juncea* and *Porophyllum gracile* (Wasbauer, 1972). I have confirmed the latter rearing record three times, but never the former record, even after many weekly samplings of *B. juncea* heads with D. W. Ricker during our ongoing, life history study of *T. imperfecta*. Therefore, the published, "unpublished" record for *Bebbia juncea* in Wasbauer (1972) was probably erroneous or atypical and rare (see discussion below), and *T. pseudovicina* normally is monophagous in heads of *Porophyllum gracile*.

Besides *T. californica*, four additional, oligophagous species of *Trupanea* in California include: *T. bisetosa*, associated with *Helianthus* spp. and other Heliantheae (Cavender and Goeden, 1982, 1983); *T. imperfecta*, principally reproducing in flower heads of *Bebbia juncea* (Bentham) Greene (Wasbauer, 1972; Goeden and Ricker, unpublished data), though rarely also transferring to and limitedly reproducing in other desert Asteraceae, e.g. *Ambrosia ilicifolia*, and related Heliantheae, e.g. *Coreopsis gigantea*; *T. signata* Foote, like *T. californica*, apparently principally infesting heads of *Anaphalis* and *Gnaphalium* spp. (Wasbauer, 1972); and *T. vicina* (van der Wulp), reported from flower heads of marigold, *Tagetes* sp. (Wasbauer, 1972), a garden ornamental widely planted and commonly infested by this fly in southern California (Goeden and Ricker, unpublished data), and also reared in small numbers, as noted above, from native hosts sampled at isolated desert locations in 1982, a year of exceptionally high rainfall.

Like *T. jonesi*, the five other generalist species have wide host ranges within the family Asteraceae in southern California: *A. femoralis*, now known from seven genera and 13 species; *A. radifera*, now known from 16 genera and 18 species; *A. actinobola*, now known from 16 genera and 26 species; *T. wheeleri*, now known from 17 genera and 24 species; and *T. nigricornis*, now known from 20 genera and 42 species (Wasbauer, 1972, and in the present work).

These rearing records represented the maximum number of flies recovered from each of one to five samples of flower heads of each plant species at different locations. The maximum numbers of each species of *Trupanea* reared varied considerably among the different host plants. The fly recoveries presumably were proportional to the nutritional suitability of the different hosts for progeny development or to the attractiveness of their flower heads for oviposition. Samples from which no flies were reared, though fairly common, are not reported here; however, some of these records probably accurately reflected complete plant resistance to tephritid attack. Four of seven new host records reported here for *T. femoralis* involved only one to four reared flies; as did nine of 16 new records for *T. wheeleri*; 13 of 29 new records for *T. jonesi*; five of 12 new records for *T. actinobola*; seven of 23 new records for *T. nigricornis*; and four of 15 new records for *T. radifera* (Wasbauer, 1972). Parasitism also reduced to an undetermined degree the numbers of flies reared. The number of heads sampled was not so

limited as to account for the rearings of so few flies. Multiple infestation of individual flower heads by single species of *Trupanea* spp. is common (Stegmaier, 1968; Cavender and Goeden, 1982; Goeden and Ricker, unpublished data). Then, too, some samples when collected may have contained larvae too young to complete their development in the excised flower heads. However, as mature flower heads mainly were sampled, this explanation might better apply to certain Tephritidae other than *Trupanea* that apparently have longer developmental periods, e.g. *Neaspilota* and *Urophora* (Goeden, unpublished data). All species of *Trupanea* that my coworkers and I have studied to date pupariate in heads and emerge as adults from mature heads. Another factor probably involved in limiting numbers of emerged flies of individual species was interspecific competition by *Trupanea* spp. and other Tephritidae for flower heads of the same host species at a particular location (synphagy) (Goeden, unpublished data).

Zwölfer (1983) noted that nonfrugivorous tephritids either are generalists with broad host ranges or specialists with narrow host ranges. Among *Trupanea* species in California, specialists are either monophagous or oligophagous. The six generalist species of *Trupanea* in California show considerable differences in their host ranges and their abilities to reproduce in the flower heads of different host species. Exploitation of less suitable hosts may be a survival mechanism for "spreading the risk" against local, catastrophic annihilation or the result of "competition for enemy-free space from specialized natural enemies," as suggested by Zwölfer (1983). Alternatively, the low numbers of flies reared from samples of certain species of plants may result from oviposition fostered by juxtaposition with a preferred host, especially at high fly densities. This "spillover" effect sometimes is observed in cage studies of host-plant specificity (Zwölfer and Harris, 1971). Whatever their cause(s), limited host-plant transfers apparently are normal occurrences in all generalist species, at least some oligophagous species, and, perhaps, even monophagous species of *Trupanea* in California.

The host relations of *Trupanea* will be further defined as additional rearing records are published. My samplings will continue, working towards a personal goal of defining the tephritid associates of all Asteraceae known from southern California.

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